













Cariogenic Risk in the Presence of Foods with Varied Glycemic Index in Dentistry Students. Cross-Sectional Study

Riesgo cariogénico en presencia de alimentos de variado índice glicémico en estudiantes de odontología. Estudio transversal

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Abstract

Introduction. Dentistry, a profession with high levels of stress, is associated with a decrease in quality of life and possible risks to oral health.

Objective. Identify the cariogenic risk from foods consumed by dentistry students in the Biobío region.

Methodology. Cross-sectional descriptive study with 178 dental students from the Biobío region (Chile), whose analysis considers the self-assessment of academic stress with the Academic Stress Inventory, cariogenic risk through the Lipari and Andrade Cariogenic Food Consumption Survey, and the glycemic index evaluated by the International Glycemic Index Tables. The statistical analysis considers the Chi-square test, with the effect size determined by Cramer's V.

Results. The students were 22.2 ± 3.1 years old. The prevalence of overweight or obesity was 44.4% (n = 79), 52.8% (n = 94) were of normal weight, and 2.8% (n = 5) were underweight. Additionally, 59.6% (n = 106) reported low stress levels and 57.8% (n = 103) had medium cariogenic risk. The analysis of cariogenic risk revealed significant differences in the intake of 14 food groups, especially those high in sugars. In the overweight/obesity subgroup, significant differences were observed in the consumption of milk, cookies, soda crackers, candies, and sweet pastries.

Conclusion. An association was found between foods rich in sugar, nutritional status, and cariogenic risk, while appetizing foods were related to academic stress.

Keywords

Cariogenic agents; overweight; obesity; stress; food quality.

Declaration of interests

The authors have declared that there is no conflict of interest.

Data availability

All relevant data is in the article. For further information, contact the corresponding author.

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Resumen

Introducción. La odontología, una profesión con elevados niveles de estrés, se asocia con una disminución en la calidad de vida y posibles riesgos para la salud bucal.

Objetivo. Identificar el riesgo cariogénico a partir de los alimentos consumidos por estudiantes de odontología en la región Biobío.

Metodología. Estudio descriptivo transversal con 178 estudiantes de odontología de la región del Biobío (Chile), cuyo análisis consideró la autoevaluación del estrés académico con el Inventario de Estrés Académico, riesgo cariogénico, a través de la Encuesta de Consumo de Alimentos Cariogénicos de Lipari y Andrade, y el índice glicémico se evaluó a partir de las Tablas Internacionales de Índice Glicémico. El análisis estadístico consideró la prueba Chi-cuadrado, siendo el tamaño del efecto determinado por la V de Cramer.

Resultados. Los estudiantes tenían $22,2 \pm 3,1$ años. La prevalencia de sobrepeso u obesidad fue del 44.4% (n = 79), el 52.8% (n = 94) presentaba normopeso y el 2.8% (n = 5) tenía bajo peso. El 59.6% (n = 106) reportó un nivel de estrés bajo y el 57.8% (n = 103) tenía riesgo cariogénico medio. El análisis del riesgo cariogénico reveló diferencias significativas en la ingesta de 14 grupos de alimentos, destacando los ricos en azúcares. En el subgrupo con sobrepeso u obesidad, se observaron diferencias significativas en el consumo de leche, galletas, galletas de soda, caramelos y pastel dulce.

Conclusión. Se encontró una asociación entre los alimentos ricos en azúcares, el estado nutricional y el riesgo cariogénico, mientras que los alimentos apetitosos se relacionaron con el estrés académico.

Palabras clave

Agentes cariogénicos; sobrepeso; obesidad; estrés; calidad de la comida.

Introduction

Dentistry is a profession characterized by generating high levels of anxiety in its students, because of which they face a growing academic load that leads to increases in stress levels and reductions in free time [1-5].

This phenomenon causes university students to increase the frequency of unhealthy habits such as prolonged fasting or a predilection for the consumption of processed foods with high glycemic index levels related to cariogenic risk [6-8]. In this sense, carious lesions usually occur as a result of the imbalance in the activity of the oral biofilm [9], where the demineralization and remineralization processes generated in the tooth enamel are frequently associated with the consumption of easily fixed fermentable carbohydrates, whose heterogeneous metabolism, in turn, induces changes in the hydrogen potential (pH), determining this change in environment for the clinical management of dental caries [10-12].

Likewise, this interaction of phenomena inside the oral cavity causes university students to be constantly exposed to a greater risk of cariogenic diseases related to unhealthy eating habits [5,6,13]. In this context, it is interesting to mention that the theoretical-practical knowledge acquired by students of careers linked to the health area is also a determining link in healthy habits, since the educational degree can

condition the self-care of both students and health professionals, that is, dentistry, which is a fundamental element when it comes to preventing carious lesions characterized by their high prevalence worldwide [14,15].

Additionally, previous studies have shown that the lifestyle and dietary choices of dental students can significantly impact their oral health outcomes [16-20]. Factors such as the frequency of water and meal intake, plus the choice of snacks along with the overall quality of the diet play a crucial role in maintaining oral health [21,22]. Stress and academic pressures often lead to neglect in these areas, further exacerbating the risk of carious lesions [18,23]. Understanding these patterns is essential for developing targeted interventions aimed at reducing cariogenic risks among dental students [20,24].

For this reason, this work aimed to identify the cariogenic risk in the presence of foods consumed by dentistry students from the Biobio region (Chile).

Methodology

Design

Cross-sectional descriptive observational design study, whose planning was carried out following the guidelines of *Strengthening the Reporting of Observational Studies in Epidemiology* [25]. The research protocol received approval from the Research Ethics Committee of the Central University of Chile through Minute No. 55/2023, in strict accordance with the Declaration of Helsinki [26].

Context

The evaluation was carried out on dentistry students at the Andrés Bello National University, located in the Biobio region (Chile). A professional specializing in dentistry verified the appropriateness of patient selection, providing each participant with a brief written description of the study, along with its objectives and the reason for selection. This process was accompanied by an informed consent that, once signed, allowed the evaluation of the cariogenic risk and glycemic index of the participants.

Population and Sample

The population was selected through non-probabilistic sampling, choosing 178 dental students who met the established eligibility criteria. The inclusion criteria for participation in the study were the following:

- Students enrolled in the professional dentistry career at the Andrés Bello National University, located in the Biobio region (Chile), during the year 2023.

In contrast, the exclusion criteria included:

- Students diagnosed with systemic diseases that could affect the results of the variables analyzed in this study.
- Students who did not grant voluntary authorization by signing a consent.

Cariogenic eating habits

Eating habits were obtained through the Lipari and Andrade Cariogenic Food Consumption Survey [27]. This tool evaluates the cariogenic potential of sugars in relation to the

patient's diet during and at the end of dental treatment. It allows establishing a closed list of foods classified according to their physical consistency, frequency, and time of consumption. For the classification of cariogenic risk, low (10 to 33 points), medium (34 to 79 points), and high (80 to 144 points) levels are considered.

In addition, the international tables of glycemic index and glycemic load values proposed by Atkinson and collaborators were applied to select the foods to be analyzed [3,4]. This was done based on the description of cariogenic foods provided by Lipari and Andrade [27].

This procedure led to the creation of 18 food groups present in the glycemic index tables, such as fruit juice, milk, white bread, soda crackers, candy, ice cream, jam, chocolate, sweet pie, cake, cookies, donuts, honey, dried fruits, fruits in syrup, nougat, chewy candy, and sugary cereals. Of the 23 food groups, 5 that were not found in these tables were not considered, such as sachet juices, tea, chewing gum, pacifiers, and undiluted powdered juice.

Academic Stress

Academic stress was evaluated using the Academic Stress Inventory (ASI). This questionnaire consists of 11 situations that allow stress to be assessed through a Likert-type scale. The weighting of academic stress is rated in values from 1 to 5, where 1 represents "No stress" and 5 "A lot of stress." The weighting of each dimension is classified as follows: 1-2 = low level; 3 = medium level; 4-5 = high level [28].

Sociodemographic evaluation

Sociodemographic variables included gender (male or female), age (years), weight, and height. These data were obtained through questions incorporated into the questionnaires applied [3,4,27,28], in addition to the classification of nutritional status obtained through the Body Mass Index [29].

Biases

Regarding possible biases, it is relevant to mention that the probability of participant selection could have been affected by the lack of blinding of the evaluators when reviewing the data. This could have influenced the differential treatment between groups, generating a potential risk of information bias. Likewise, the dentistry career is mostly a profession practiced by women, being an indication of a possible selection bias.

Sample size

The 330 students of the dentistry program taught by the Andres Bello National University, located in the Biobio region (Chile), determined the sample size. A 95% confidence interval (CI) and a 5% margin of error were established, obtaining a minimum necessary sample size of 178.

Statistical analysis

The data were analyzed using IBM SPSS Statistics software for Windows operating system, version 27. Normality in the data distribution was evaluated using the Kolmogorov-Smirnov test. Measures of central tendency and dispersion, such as the mean and standard deviation, were used to describe the quantitative variables. In addition, relative and absolute frequencies were used to describe the qualitative variables. In the inferential analysis, Pearson's Chi square test was applied, with the significance level $\alpha = 0.05$ for all analyses. Additionally, the

effect size for the qualitative variables was calculated using Cramer’s “V”, considering the classification values based on the degrees of freedom.

Results

A sample of 178 students (60 men and 118 women) was analyzed. In general terms, the students were between 18 and 35 years old, with an average of 22.2 ± 3.1 years, an average nutritional status of overweight (25.2 ± 4.2), an average level of low academic stress (22.8 ± 0.2), and a medium cariogenic risk (63 ± 24.4), as seen in Table 1.

Table 1. Baseline characteristics of the analyzed sample (n = 178).

Numerical variables	$\bar{x} \pm \sigma$
Age (years)	22,2 ± 3,1
Weight (kg)	69,5 ± 15,1
Size (cm)	165,6 ± 8,5
BMI (kg/m ²)	25,2 ± 4,2
Academic stress	2,8 ± 0,9
Cariogenic risk	63 ± 24,4

Note. \bar{x} : Mean, σ : Standard deviation.

Table 2 analyzes the association between cariogenic risk and the study variables, where homogeneity of cariogenic risk is seen depending on gender ($g1 = 2$; $p = 0.73$; $w = 0.06$), nutritional status ($df = 6$; $p = 0.19$; $w = 0.16$), and academic stress ($df = 4$; $p = 0.23$; $w = 0.13$). Regarding food intake, white bread ($df = 2$; $p = 0.09$; $w = 0.17$), ice cream ($df=2;p=0.13;w=0.15$), jam ($df = 2$; $p = 0.48$; $w = 0.09$), honey ($df = 2$; $p = 0.40$; $w = 0.10$), and dried fruits ($df = 2$; $p = 0.57$; $w = 0.08$) do not present statistically significant differences with small effect sizes.

In relation to the behavior of the overweight/obesity condition as a function of cariogenic risk, statistically significant differences with medium to large effect sizes are only observed on milk intake ($df = 2$; $p = 0.01$; $w = 0.33$), cookies ($df = 2$; $p < 0.001$; $w = 0.42$), soda crackers ($df = 2$; $p = 0.03$; $w = 0.29$), candies ($df = 2$; $p = 0.03$; $w = 0.30$), and sweet cake ($df=2;p=0.02;w=0.31$), as seen in Table 3.

Discussion

The findings of this study reveal a complex relationship between food consumption and cariogenic risk among dentistry students at Andrés Bello National University in the Biobío region, Chile. The prevalence of overweight and obesity in this population exceeds that observed in the general population of Chilean university students [30], suggesting an obesogenic environment in higher education where diet and physical inactivity play determining roles [30-32].

A possible explanation for this behavior is that cariogenic risk does not necessarily depend on educational level. In fact, a high risk has been observed despite students’ awareness and knowledge of good oral hygiene habits [18,19]. Instead, factors such as food consump-

Table 2. Association of cariogenic risk with the study variables (n = 178).

Variables		Cariogenic risk classification			Statisticians			Effect size
		Low (n = 21)	Medium (n = 103)	High (n = 54)	df	p	w	
Nutritional condition	Under weight	2 (9,5 %)	1 (1%)	2 (3,7 %)	6	0,19	0,16	Medium
	Healthy	11 (52,4 %)	58 (56,3 %)	25 (46,3 %)				
	Overweight	7 (33,3 %)	31 (30,1 %)	23 (42,6 %)				
	Obesity	1 (4,8 %)	13 (12,6 %)	4 (7,4 %)				
Academic stress	Low	12 (57,1 %)	67 (65,1 %)	27 (50 %)	4	0,23	0,13	Low
	Medium	5 (23,8 %)	26 (25,2 %)	15 (27,8 %)				
	High	4 (19,1)	10 (9,7 %)	12 (22,2 %)				
Gender	Male	7 (33,3%)	37 (35,9%)	16 (29,6%)	2	0,73	0,06	Low
	Female	14 (66,7%)	66 (64,1%)	38 (70,4%)				
Fruit juice	Yes	10 (47,6%)	72 (69,9%)	43 (79,6%)	2	0,02	0,20	Low
	Not	11 (52,4%)	31 (30,1%)	11 (20,4%)				
Milk	Yes	-	16 (15,5%)	15 (27,8%)	2	0,01	0,22	Medium
	Not	21 (100%)	87 (84,5%)	39 (72,2%)				
White bread	Yes	13 (61,9%)	81 (78,6%)	46 (85,2%)	2	0,09	0,17	Low
	Not	8 (38,1%)	22 (21,4%)	8 (14,8%)				
Soda cookies	Yes	9 (42,9%)	44 (42,7%)	36 (66,7%)	2	0,01	0,22	Medium
	Not	12 (57,1%)	59 (57,3%)	18 (33,3%)				
Candies	Yes	5 (23,8%)	55 (53,4%)	42 (77,8%)	2	<0,001	0,33	Medium
	Not	16 (76,2%)	48 (46,6%)	12 (22,2%)				
Ice cream	Yes	14 (66,7%)	75 (72,8%)	46 (85,2%)	2	0,13	0,15	Low
	Not	7 (33,3%)	28 (27,2%)	8 (14,8%)				
Jam	Yes	7 (33,3%)	48 (46,6%)	26 (48,1%)	2	0,48	0,09	Low
	Not	14 (66,7%)	55 (53,4%)	28 (51,9%)				
Chocolate	Yes	14 (66,7%)	81 (78,6%)	50 (92,6%)	2	0,02	0,21	Medium
	Not	7 (33,3%)	22 (21,4%)	4 (7,4%)				
Sweet cake	Yes	9 (42,9%)	80 (77,7%)	48 (88,9%)	2	<0,001	0,32	Medium
	Not	12 (57,1%)	23 (22,3%)	6 (11,1%)				
Cake	Yes	8 (38,1%)	73 (70,9%)	47 (87%)	2	<0,001	0,32	Medium
	Not	13 (61,9%)	30 (29,1%)	7 (13%)				
Cookies	Yes	11 (52,4%)	88 (85,4%)	51 (94,4%)	2	<0,001	0,34	Medium
	Not	10 (47,6%)	15 (14,6%)	3 (5,6%)				
Donuts	Yes	5 (23,8%)	59 (57,3%)	38 (70,4%)	2	<0,001	0,27	Medium
	Not	16 (76,2%)	44 (42,7%)	16 (29,6%)				
Honey	Yes	8 (38,1%)	43 (41,7%)	28 (51,9%)	2	0,40	0,10	Low
	Not	13 (61,9%)	60 (58,3%)	26 (48,1%)				

Dry fruits	Yes	13 (61,9%)	58 (56,3%)	35 (64,8%)	2	0,57	0,08	Low
	Not	8 (38,1%)	45 (43,7%)	19 (35,2%)				
Fruits in syrup	Yes	1 (4,8%)	20 (19,4%)	10 (18,5%)	2	0,03	0,12	Low
	Not	20 (95,2%)	83 (80,6%)	44 (81,5%)				
Nougat	Yes	4 (19%)	25 (24,3%)	24 (44,4%)	2	0,02	0,22	Medium
	Not	17 (81%)	78 (75,7%)	30 (55,6%)				
Chewy candy	Yes	4 (19%)	47 (45,6%)	34 (63%)	2	0,002	0,26	Medium
	Not	17 (81%)	56 (54,4%)	20 (37%)				
sugary cereal	Yes	6 (28,6%)	61 (59,2%)	41 (75,9%)	2	<0,001	0,29	Medium
	Not	6 (75 %)	21 (47,7 %)	9 (33,3 %)				

Note. df: degrees of freedom, p: bilateral significance value p, w: Cramer's V statistic.

Table 3. Association of cariogenic risk in variables of the overweight/obesity subgroup (n = 79).

Variables		Cariogenic risk classification			Statisticians			Effect size.
		Low (n = 8)	Medium (n = 44)	High (n = 27)	df	p	w	
Nutritional condition	Overweight	7 (87,5 %)	31 (70,5 %)	23 (85,2 %)	2	0,27	0,18	Low
	Obesity	1 (12,5 %)	13 (29,5 %)	4 (14,8 %)				
Academic stress	Low	4 (50 %)	31 (70,5 %)	15 (55,6 %)	4	0,14	0,21	Medium
	Medium	1 (12,5 %)	10 (22,7 %)	8 (29,6 %)				
	High	3 (37,5 %)	3 (6,8 %)	4 (14,8 %)				
Gender	Male	4 (50 %)	18 (40,9 %)	10 (37 %)	2	0,80	0,07	Low
	Female	4 (50 %)	26 (59,1 %)	17 (63 %)				
Fruit juice	Yes	3 (37,5 %)	29 (65,9 %)	22 (81,5 %)	2	0,06	0,27	Medium
	Not	5 (62,5 %)	15 (34,1 %)	5 (18,5 %)				
Milk	Yes	-	2 (4,5 %)	7 (25,9 %)	2	0,01	0,33	Medium
	Not	8 (100 %)	42 (95,5 %)	20 (74,1 %)				
White bread	Yes	5 (62,5 %)	37 (84,1 %)	23 (85,2 %)	2	0,30	0,17	Low
	Not	3 (37,5 %)	7 (15,9 %)	4 (14,8 %)				
Soda cookies	Yes	1 (12,5 %)	19 (43,2 %)	17 (63 %)	2	0,03	0,29	Medium
	Not	7 (87,5 %)	25 (56,8 %)	10 (37 %)				
Candies	Yes	2 (25 %)	19 (43,2 %)	19 (70,4 %)	2	0,03	0,30	Medium
	Not	6 (75 %)	25 (56,8 %)	8 (29,6 %)				
Ice cream	Yes	6 (75 %)	34 (77,3 %)	22 (81,5 %)	2	0,89	0,06	Low
	Not	2 (25 %)	10 (22,7 %)	5 (18,5 %)				
Jam	Yes	3 (37,5 %)	16 (36,4 %)	11 (40,7 %)	2	0,93	0,04	Low
	Not	5 (62,5 %)	28 (63,6 %)	16 (59,3 %)				
Chocolate	Yes	6 (75 %)	33 (75 %)	24 (88,9 %)	2	0,35	0,16	Low
	Not	2 (25 %)	11 (25 %)	3 (11,1 %)				

Sweet cake	Yes	4 (50 %)	31 (70,5 %)	25 (92,6 %)	2	0,02	0,31	Medium
	Not	4 (50 %)	13 (29,5 %)	2 (7,4 %)				
Cake	Yes	4 (50 %)	30 (68,2 %)	23 (85,2 %)	2	0,10	0,24	Medium
	Not	4 (50 %)	14 (31,8 %)	4 (14,8 %)				
Cookies	Yes	4 (50 %)	40 (90,1 %)	26 (96,3 %)	2	<0,001	0,42	High
	Not	4 (50 %)	4 (9,9 %)	1 (3,7 %)				
Donuts	Yes	2 (25 %)	24 (54,6 %)	18 (66,7 %)	2	0,11	0,24	Medium
	Not	6 (75 %)	20 (45,4 %)	9 (33,3 %)				
Honey	Yes	2 (25 %)	14 (31,8 %)	10 (37 %)	2	0,80	0,08	Low
	Not	6 (75 %)	30 (68,2 %)	17 (63 %)				
Dry fruits	Yes	6 (75 %)	18 (40,9 %)	17 (63 %)	2	0,08	0,26	Medium
	Not	2 (25 %)	26 (59,1 %)	10 (37 %)				
Fruits in syrup	Yes	-	8 (18,2 %)	5 (18,5 %)	2	0,42	0,15	Low
	Not	8 (100 %)	36 (81,8 %)	22 (81,5 %)				
Nougat	Yes	2 (25 %)	9 (20,4 %)	12 (44,4 %)	2	0,09	0,25	Medium
	Not	6 (75 %)	35 (79,6 %)	15 (55,6 %)				
Chewy candy	Yes	2 (25 %)	18 (40,9 %)	17 (63 %)	2	0,08	0,25	Medium
	Not	6 (75 %)	26 (59,1 %)	10 (37 %)				
Sugary cereal	Yes	2 (25 %)	23 (52,3 %)	18 (66,7 %)	2	0,11	0,24	Medium
	Not	6 (75 %)	21 (47,7 %)	9 (33,3 %)				

Note. df: degrees of freedom, p: bilateral significance value p, w: Cramer's V statistic.

tion, nutritional status, and physical activity levels modulate cariogenic risk. Diet and dietary habits are key determinants in the occurrence of dental caries in adults who attend tertiary health centers [19,33].

The study highlights a high prevalence of cariogenic risk associated with the intake of foods such as fruit juices, white bread, sweets, ice cream, chocolates, pastries, cakes, cookies, donuts, nuts, and cereals. These foods, rich in carbohydrates (glucose and fructose), contribute to the development of anabolic effector systems responsible for the lipogenesis process [3,4,34]. Dental plaque exposed to sugars like sucrose can rapidly produce acids, causing a rapid drop in pH followed by a gradual recovery towards the initial oral pH. This pH instability generates an oral environment conducive to the growth of the bacteria *S. mutans* [10,11].

The exopolysaccharide matrix produced by bacteria such as *S. mutans* is a key factor in the virulence of the cariogenic biofilm. The metabolism of these exopolysaccharides is considered a potential preventive strategy for the formation of cariogenic biofilms. However, this approach contradicts the results of the study, which indicate a low consumption of foods such as honey (55.6%), a phenomenon possibly attributed to marketing and public policies that directly influence consumer habits, regardless of the nutritional quality of the products [35,36].

Moreover, it is known that academic stress, often related to anxiety, can modulate the consumption of sugary drinks, fast food, and pastries [37-39]. This behavior aligns with the low to moderate stress classification observed in the present study. In relation to cariogenic risk,

significant differences are observed in the frequency of consumption of fruit juice, milk, soda crackers, candy, chocolate, sweet cake, cake, cookies, donuts, nougat, and sugary cereals. A cariogenic diet characterized by a high sugar content, such as sucrose, can adhere to the tooth surface, generating dysbiosis that favors enamel demineralization and the formation of dental caries [40-42].

The analysis of the overweight/obesity subgroup shows significant differences in the consumption of sugar-rich foods (milk, candy, sweet cake, cookies, and soda crackers), indicating that these can modulate cariogenic risk. Although the etiology of dental caries is determined by multiple intrinsic and extrinsic factors, the frequency of food consumption, time of ingestion, concentration of sugars, and pH of food contribute to varying degrees to cariogenic risk [42].

Regarding the limitations of the study, it is important to note that the self-perception of healthy foods by each student could have altered the results. The absence of validated dietary surveys for food recording is also a limitation. Although a report was made based on food categories according to the international table of glycemic index and load values published in 2008 and 2021, it is suggested for future research to apply validated questionnaires that include typical Chilean preparations or to conduct a 24-hour recall with a food consumption trend survey. To date, there are no validated questionnaires on the glycemic index with typical Chilean preparations. However, the use of international tables of glycemic index and load values proved to be a useful tool for classifying the glycemic index of the food products consumed by the subjects in the cariogenic risk survey.

Conclusion

The findings of the present study suggest the possibility of an association between the frequency of consumption of foods rich in sugars with nutritional status, academic stress, and cariogenic risk in dental students. Nevertheless, it is important to highlight that future research should focus on the use of instruments that allow a precise assessment of intake to obtain more robust conclusions.

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